US008503394B2

(12) **United States Patent**
Lee et al.

(10) **Patent No.: US 8,503,394 B2**
(45) **Date of Patent: Aug. 6, 2013**

(54) **METHOD OF FAST UPLINK DATA TRANSMISSION FOR HANDOVER**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 494 days.

(21) Appl. No.: **12/678,484**

(22) PCT Filed: **Sep. 26, 2008**

(86) PCT No.: **PCT/KR2008/005711**

§ 371 (c)(1),
(2), (4) Date: **Mar. 16, 2010**

(87) PCT Pub. No.: **WO2009/045027**

PCT Pub. Date: **Apr. 9, 2009**

(65) **Prior Publication Data**

US 2010/0208696 A1 Aug. 19, 2010

(30) **Foreign Application Priority Data**

Oct. 1, 2007 (KR) 10-2007-0098695

(51) **Int. Cl.**
H04W 4/00 (2009.01)

(52) **U.S. Cl.**
USPC **370/331**; 455/431

(58) **Field of Classification Search**
USPC 370/331; 455/437
See application file for complete search history.

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(57) **ABSTRACT**

A fast uplink data transmission method for a handover is disclosed. This method effectively uses a handover signal when there is data to be transmitted to an uplink during an Intra Radio Access Technology (I-RAT) handover, such that it quickly transmits and receives uplink data. The method of transmitting uplink data in a wireless access system includes, transmitting a message including an information bit to a target base station by a mobile station during a handover, wherein the information bit indicates whether the uplink data is present, and receiving a radio resource for transmitting the uplink data from the target base station, if the information bit indicates the uplink data is present, wherein the radio resource is allocated by the target base station. So, uplink user data can be quickly transmitted to a destination while the UE performs the handover.

4 Claims, 5 Drawing Sheets

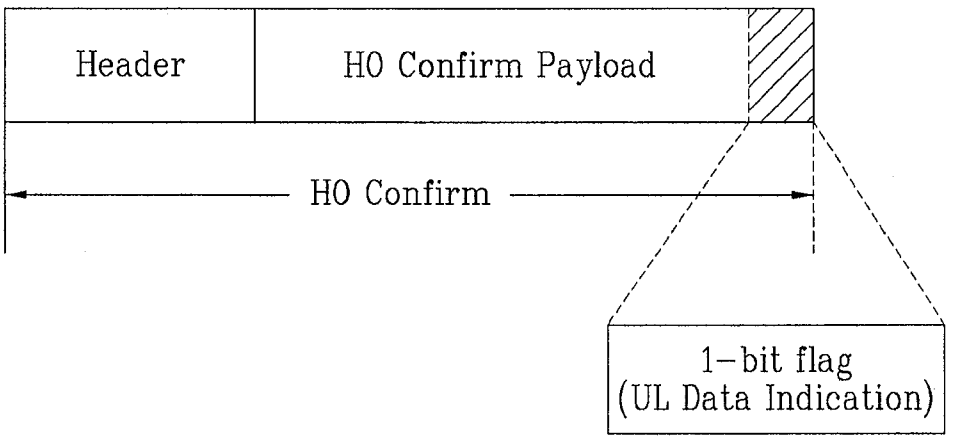


FIG. 1

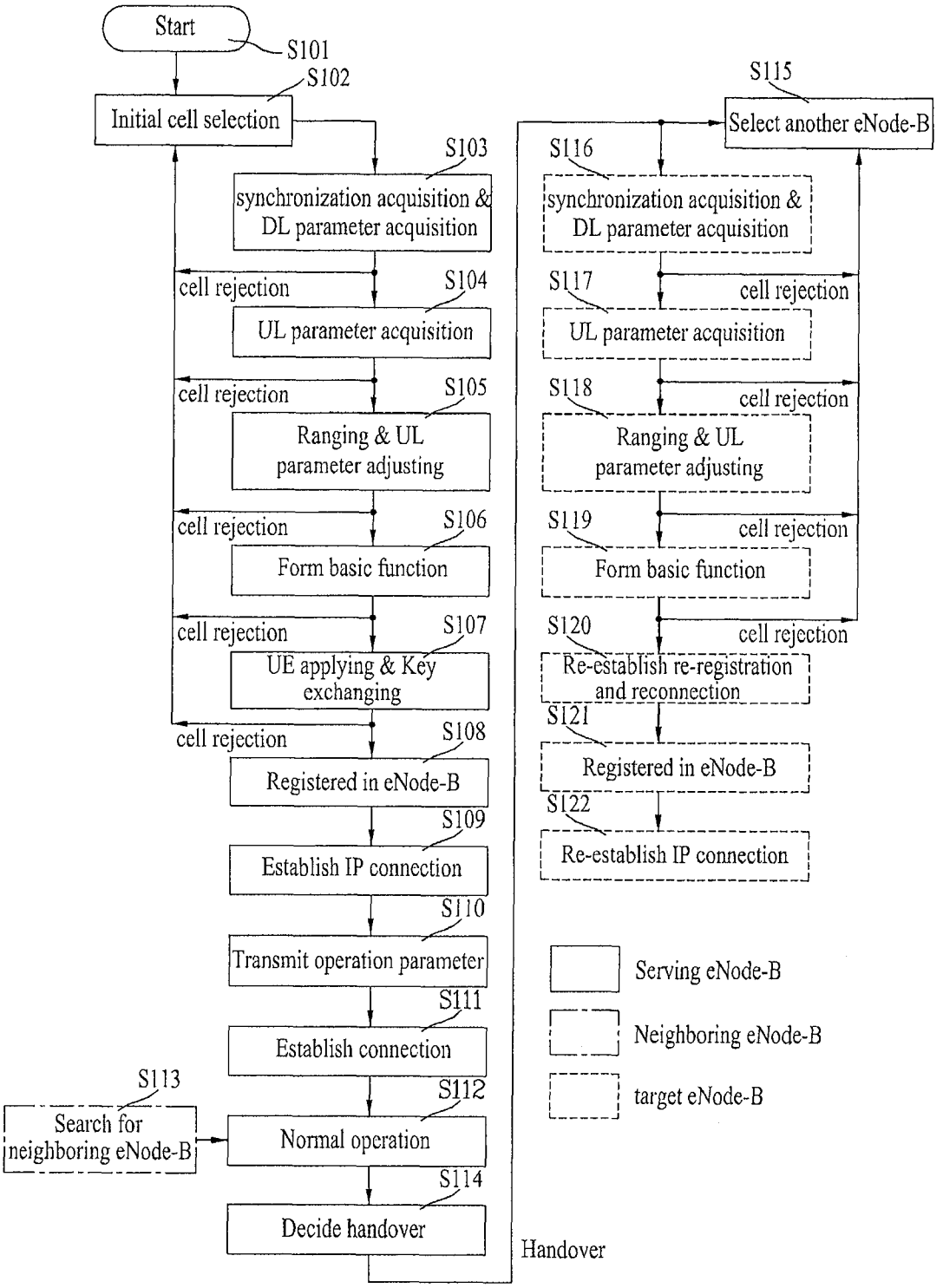

Start
S101
S102
Initial cell selection
S103
synchronization acquisition & DL parameter acquisition
cell rejection
S104
UL parameter acquisition
cell rejection
S105
Ranging & UL parameter adjusting
cell rejection
S106
Form basic function
cell rejection
S107
UE applying & Key exchanging
cell rejection
S108
Registered in eNode-B
S109
Establish IP connection
S110
Transmit operation parameter
S111
Establish connection
S113
Search for neighboring eNode-B
S112
Normal operation
S114
Decide handover
Handover
S115
Select another eNode-B
S116
synchronization acquisition & DL parameter acquisition
S117
cell rejection
UL parameter acquisition
S118
cell rejection
Ranging & UL parameter adjusting
S119
cell rejection
Form basic function
S120
cell rejection
Re-establish re-registration and reconnection
S121
Registered in eNode-B
S122
Re-establish IP connection
Serving eNode-B
Neighboring eNode-B
target eNode-B

FIG. 2

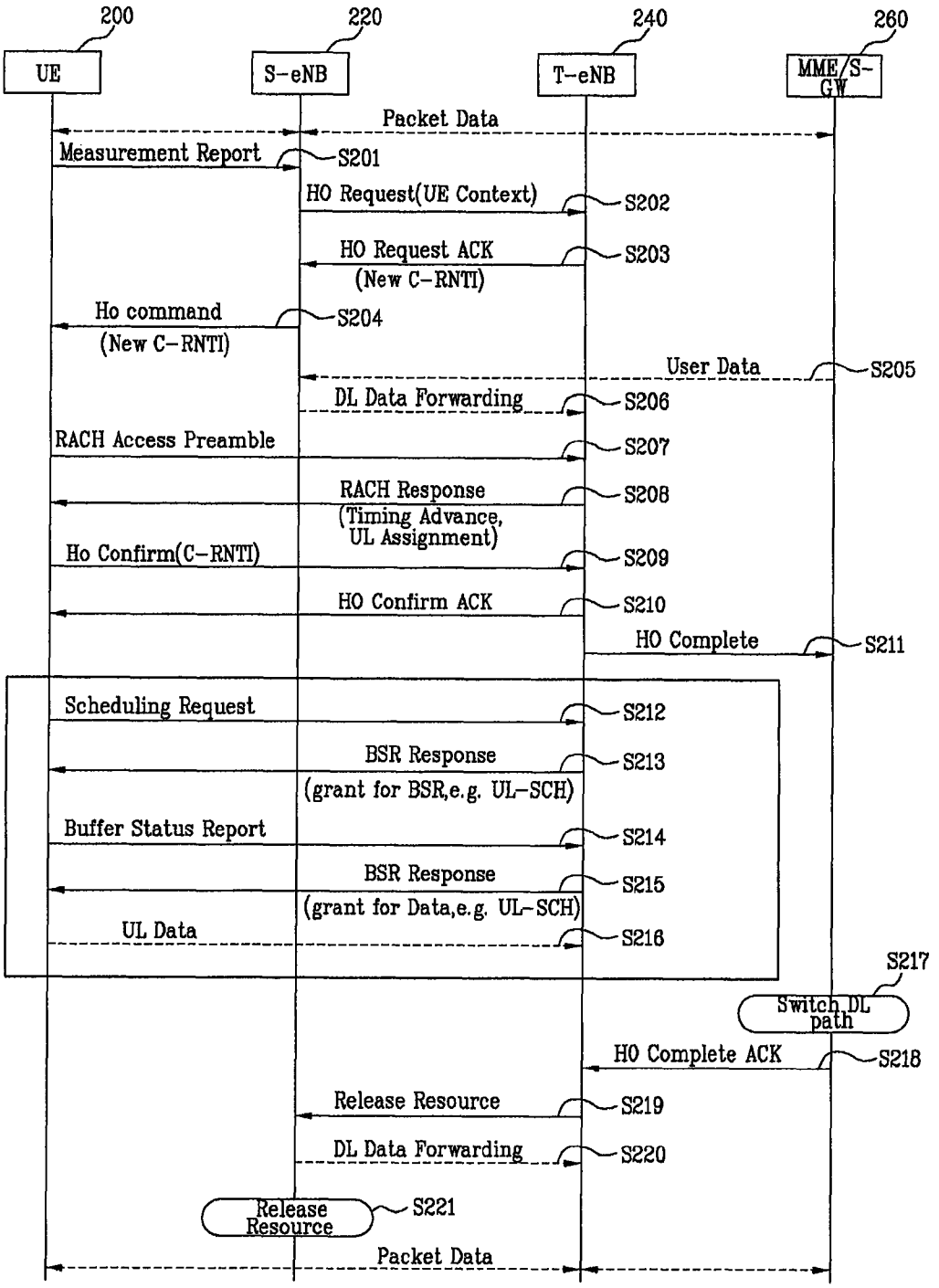

200
220
240
260
UE
S-eNB
T-eNB
MME/S-GW
Packet Data
Measurement Report
S201
HO Request(UE Context)
S202
HO Request ACK
(New C-RNTI)
S203
Ho command
(New C-RNTI)
S204
User Data
S205
DL Data Forwarding
S206
RACH Access Preamble
S207
RACH Response
(Timing Advance, UL Assignment)
S208
Ho Confirm(C-RNTI)
S209
HO Confirm ACK
S210
HO Complete
S211
Scheduling Request
S212
BSR Response
(grant for BSR,e.g. UL-SCH)
S213
Buffer Status Report
S214
BSR Response
(grant for Data,e.g. UL-SCH)
S215
UL Data
S216
S217
Switch DL path
HO Complete ACK
S218
Release Resource
S219
DL Data Forwarding
S220
Release Resource
S221
Packet Data

FIG. 3

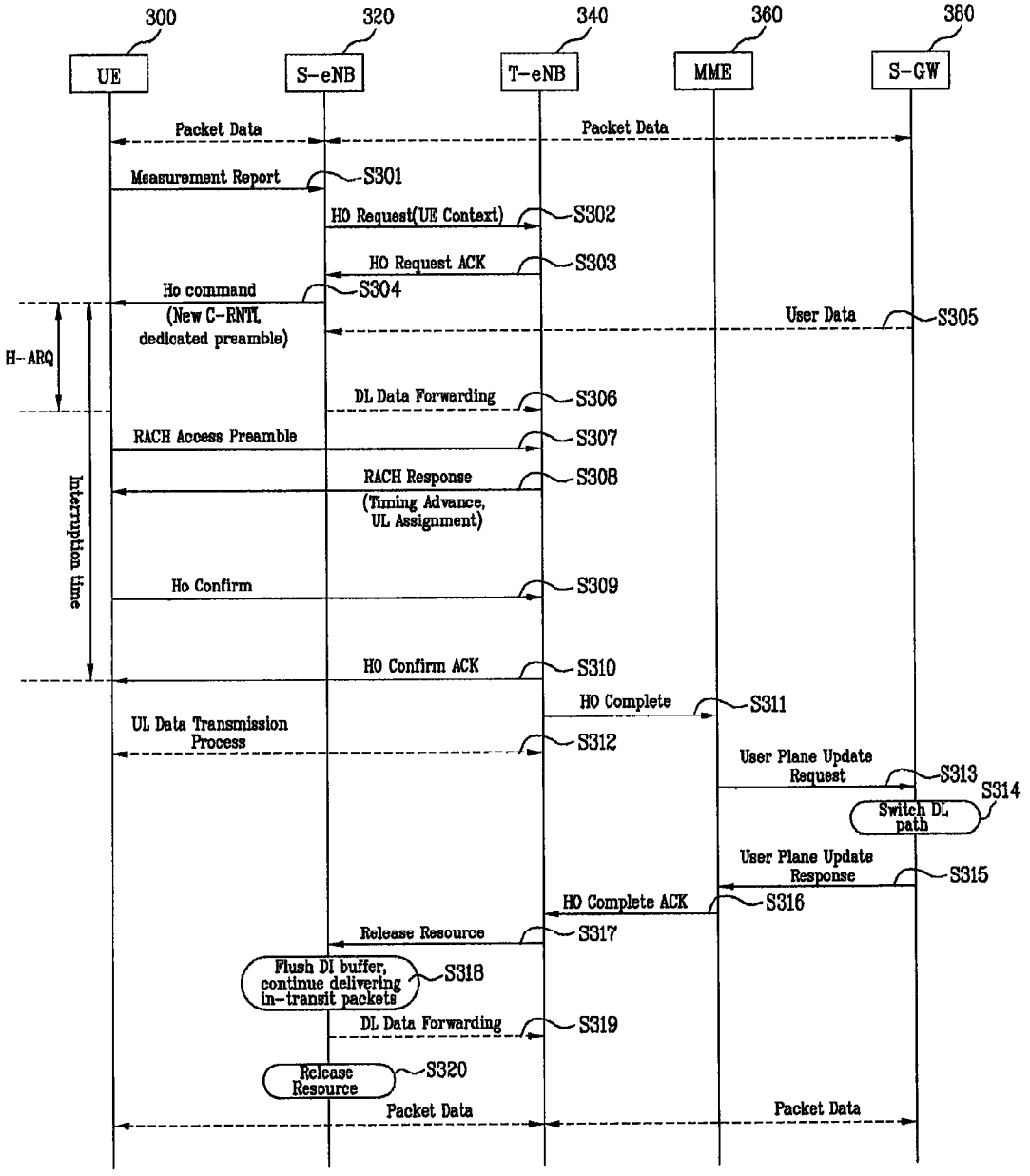

300
320
340
360
380
UE
S-eNB
T-eNB
MME
S-GW
Packet Data
Packet Data
Measurement Report
S301
HO Request(UE Context)
S302
HO Request ACK
S303
Ho command
S304
(New C-RNTI, dedicated preamble)
User Data
S305
H-ARQ
DL Data Forwarding
S306
RACH Access Preamble
S307
RACH Response
S308
(Timing Advance, UL Assignment)
Interruption time
Ho Confirm
S309
HO Confirm ACK
S310
HO Complete
S311
UL Data Transmission Process
S312
User Plane Update Request
S313
S314
Switch DL path
User Plane Update Response
S315
HO Complete ACK
S316
Release Resource
S317
Flush DI buffer, continue delivering in-transit packets
S318
DL Data Forwarding
S319
Release Resource
S320
Packet Data
Packet Data

FIG. 4

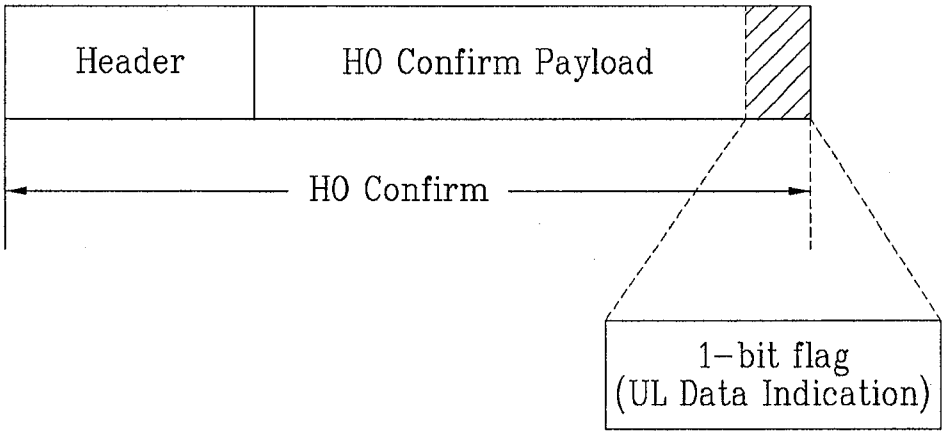
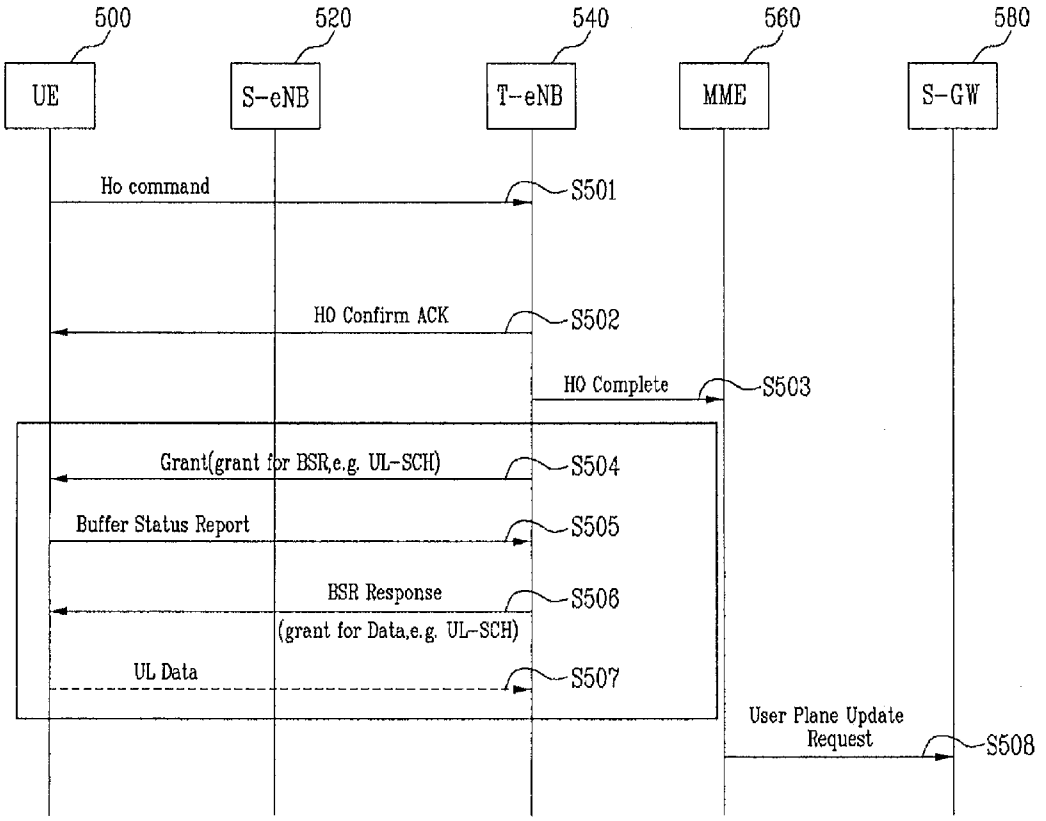

Header
HO Confirm Payload
HO Confirm
1-bit flag
(UL Data Indication)

FIG. 5


500
520
540
560
580
UE
S-eNB
T-eNB
MME
S-GW
Ho command
S501
HO Confirm ACK
S502
HO Complete
S503
Grant(grant for BSR,e.g. UL-SCH)
S504
Buffer Status Report
S505
BSR Response
(grant for Data,e.g. UL-SCH)
S506
UL Data
S507
User Plane Update Request
S508

METHOD OF FAST UPLINK DATA TRANSMISSION FOR HANDOVER

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is the National Stage filing under 35 U.S.C. 371 of International Application No. PCT/KR2008/005711, filed on Sep. 26, 2008, which claims the benefit of earlier filing date and right of priority to Korean Application No. 10-2007-0098695, filed on Oct. 1, 2007.

TECHNICAL FIELD

The present invention relates to a wireless communication system, and more particularly to a method for effectively using a handover signal when there is data to be transmitted to an uplink during an Intra Radio Access Technology (I-RAT) handover, such that it quickly transmits and receives uplink data.

BACKGROUND ART

Generally, a handover function is as follows. According to a handover, although a mobile terminal (also called a user equipment (UE)) making a phone call to another mobile terminal in a communication zone (e.g., a mobile communication cell) moves from an area of one base station (also called an e-nodeB) to an area of another base station (i.e., another eNode-B), a handover from one base station to another base station is carried out, such that the mobile terminal can continuously keep making the phone call to another mobile terminal.

The handover occurs when a radio frequency (RF) channel currently used by a mobile station subscriber (i.e., UE) is in poor condition, or also occurs when the mobile station subscriber UE moves from a current eNode-B area to another eNode-B area.

The handover may be classified into a softer handover, a soft handover, and a hard handover according to channel switching methods.

The softer handover is carried out in one cell, and may indicate that a channel used by the UE is switched to a good channel from among channels of a UE's cell coverage. The soft handover indicates that two neighboring channels are simultaneously operated and finally one of the two neighboring channels is slowly severed. According to Code Division Multiple Access (CDMA) scheme, two or more eNode-Bs use the same frequency band, such that this soft handover can be easily implemented in the CDMA scheme. According to the hard handover, a current call-connected channel is severed, and is immediately connected to another channel.

According to the entity carrying out the above-mentioned handover, the handover may be classified into a Network Controlled Handoff (NCHO), a Mobile Assisted Handoff (MAHO), a Mobile Controlled Handoff (MCHO), etc.

The soft handover and the MAHO from among the above-mentioned schemes will hereinafter be described in detail. Needless to say, another handover method may also be used.

An Intra Radio Access Technology (I-RAT) handover supports a handover between homogeneous networks. If a UE moves from one eNode-B (i.e., a serving eNode-B) to another eNode-B (i.e., a target eNode-B) within the range of a homogeneous network, the I-RAT handover provides this UE with a seamless handover and service continuity, resulting in greater convenience of a user of the UE.

FIG. **1** is a flow chart illustrating a handover and initial network entry process.

Referring to FIG. **1**, a UE enters a handover and initial network entry process, and selects a cell at steps **S101** and **S102**. During this cell selection, the UE performs a scanning or ranging process together with one or more eNode-Bs in order to search for a desired eNode-B appropriate for either a network connection or a handover. The UE must perform scheduling either the scanning or sleep period such that it can determine whether or not the UE enters an initial network of the eNode-B or is handed over to a target eNode-B (T-eNB).

When the UE enters the initial network, it establishes synchronization with a serving station (also called a serving eNode-B) and a downlink parameter at step **S103**. The serving eNode-B (S-eNB) provides services over a network to which the UE will belong. The UE synchronized with the serving eNode-B (S-eNB) acquires an uplink parameter for the serving eNode-B (S-eNB) at step **S104**. Then, the UE performs the ranging process along with the serving eNode-B (S-eNB) and adjusts uplink parameters for the serving eNode-B (S-eNB) at step **S105**. By the above-mentioned steps, the UE and the serving eNode-B (S-eNB) form a basic function for communication at step **S106**. The serving eNode-B (S-eNB) provides the UE and exchanges keys with the UE at step **S107**. Thus, the UE is registered in the serving eNode-B (S-eNB) at step **S108**, and establishes an IP connection at step **S109**.

The serving eNode-B (S-eNB) transmits operation parameters to the UE such that the UE performs a communication process at step **S110**. If a connection between the UE and the serving eNode-B (S-eNB) is established at step **S111**, the UE and the serving eNode-B can be normally operated at step **S112**. While the serving eNode-B (S-eNB) is normally operated, the UE continuously searches for a neighboring eNode-B at step **S113**, because a quality of service (QoS) is lowered in proportion to the distance from the UE to the serving eNode-B (S-eNB). Therefore, the neighboring eNode-B providing services better than those of the serving eNode-B (S-eNB) is called a target station (i.e., a target eNode-B), such that it can perform the handover to the target eNode-B.

Generally, the handover is carried out when the UE moves from the serving eNode-B (S-eNB) to the target eNode-B (T-eNB). The handover indicates that a wireless interface, service flow, and network access point of the UE are handed over to the target eNode-B (T-eNB). When the UE, the serving eNode-B (S-eNB), or the network administrator determines the handover at step **S114**, this handover begins.

The UE selects the target eNode-B (T-eNB) at step **S115**, establishes synchronization with the target eNode-B (T-eNB) and acquires downlink parameters at step **S116**. The UE acquires uplink parameters of the target eNode-B (T-eNB) at step **S117**, performs the ranging process together with the target eNode-B (S-eNB) and adjusts uplink parameters at step **S118**. In this case, if the UE pre-receives an identifier, frequency, and uplink/downlink channel descriptors (UCD/DCD) of the target eNode-B (T-eNB), the scanning process and the synchronization process can be simplified. If the target eNode-B (T-eNB) receives a handover notification message from the serving eNode-B (S-eNB) over a backbone network, a non-competitive initial ranging opportunity can be provided to an UL-MAP.

By the above-mentioned steps, the target eNode-B (T-eNB) forms the basic function at step **S119**, and the UE and the target eNode-B (T-eNB) perform the ranging and begins to perform the network re-entry process. The UE is re-registered in the target eNode-B (T-eNB), and is re-con-

nected to the target eNode-B (T-eNB) at step **S120**. Thus, the terminal is registered in the target eNode-B (T-eNB) at step **S121**. The IP connection of the target eNode-B (T-eNB) is re-established in the UE at step **S122**. By the above-mentioned steps, the target eNode-B (T-eNB) serves as the serving eNode-B (S-eNB), and can provide the UE with necessary services.

DISCLOSURE

Technical Problem

Accordingly, the present invention is directed to a fast uplink data transmission method for a handover that substantially obviates one or more problems due to limitations and disadvantages of the related art.

If there is a need to transmit uplink data during a generally handover, various complicated processes for transmitting this uplink data are needed. For example, the UE can request radio resources for transmitting uplink data from a target eNode-B (T-eNB), and can transmit the uplink data via the radio resources allocated from the target eNode-B (T-eNB).

An object of the present invention is to provide a method for allowing a user equipment (UE) to transmit uplink data when uplink data exists during the handover.

Another object of the present invention is to provide a method for effectively using a handover signal when data to be transmitted to an uplink exists during the handover, such that the UE can quickly transmit uplink data.

Yet another object of the present invention is to provide a method for quickly transmitting uplink data when the UE performs the handover.

Technical Solution

To achieve these objects and other advantages and in accordance with the purpose of the invention, as embodied and broadly described herein, a method of transmitting uplink data in a wireless access system, the method including: transmitting a message including an information bit to a target base station by a mobile station during handover, wherein the information bit indicates whether the uplink data is present; and receiving a radio resource for transmitting the uplink data from the target base station, if the information bit indicates the uplink data is present, wherein the radio resource is allocated by the target base station.

The message including the information bit may be a handover confirm (HO Confirm) message.

The method may further comprise, transmitting the uplink data via the radio resource to the target base station.

In the receiving of the radio resource, the radio resource may be transmitted using a response message according to the message from the target base station.

The method may further include, providing quality of signal information to a serving base station periodically by the mobile station; receiving a message including a dedicated preamble and an identifier of the mobile station from the serving base station, wherein the identifier is used at the target base station; and synchronizing with the target base station using at least one of the identifier and the dedicated preamble.

In another aspect of the present invention, there is provided a method of receiving an uplink data in a wireless access system, the method including: receiving a message including a information bit from a mobile station, wherein the information bit indicates whether the uplink data is present, and the mobile station is performing a handover; and allocating a radio resource for receiving the uplink data to the mobile station, if the information bit indicates the uplink data is present.

The message including the information bit may be a handover confirm (HO Confirm) message.

The method may further include, synchronizing with the mobile station before receiving the message.

The method may further include, receiving a message requiring handover of the mobile station from the serving base station; and transmitting a message including an identifier of the mobile station and a dedicated preamble to the mobile station, wherein the identifier is used at the target base station.

If the uplink data is present, the information bit may be set to '1', and if the uplink data is not present, the information bit may be set to '0'.

It is to be understood that both the foregoing general description and the following detailed description of the present invention are exemplary and explanatory and are intended to provide further explanation of the invention as claimed.

Advantageous Effects

The present invention has the following effects.

First, according to embodiments of the present invention, uplink user data can be quickly transmitted to a desired destination while the UE performs the handover.

Second, according to the embodiments of the present invention, the UE can quickly transmit uplink user data to a destination, such that it can reduce a delay time caused by the handover.

Third, according to the embodiments of the present invention, the UE can quickly transmit uplink data after performing the handover.

DESCRIPTION OF DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention, illustrate embodiments of the invention and together with the description serve to explain the principle of the invention.

In the drawings:

FIG. **1** is a flow chart illustrating a handover and initial network entry process;

FIG. **2** is a flow chart illustrating an I-RAT handover process of the UE according to the present invention;

FIG. **3** is a flow chart illustrating a signal processing step performed when there is uplink data during the UE's handover according to one embodiment of the present invention;

FIG. **4** is a structural diagram illustrating an HO Confirm message according to another embodiment of the present invention; and

FIG. **5** is a flow chart illustrating a method for allowing the UE to transmit user data to an uplink during the handover according to yet another embodiment of the present invention.

BEST MODE

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings. Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or like parts.

The following embodiments of the present invention relate to a wireless communication system, and more particularly to

a method for effectively using a handover signal when there is data to be transmitted to an uplink during an Intra Radio Access Technology (I-RAT) handover, such that it quickly transmits and receives uplink data.

The following embodiments are proposed by combining constituent components and characteristics of the present invention according to a predetermined format. The individual constituent components or characteristics should be considered to be optional factors on the condition that there is no additional remark. If required, the individual constituent components or characteristics may not be combined with other components or characteristics. Also, some constituent components and/or characteristics may be combined to implement the embodiments of the present invention. The order of operations to be disclosed in the embodiments of the present invention may be changed to another. Some components or characteristics of any embodiment may also be included in other embodiments, or may be replaced with those of the other embodiments as necessary.

The above-mentioned embodiments of the present invention are disclosed on the basis of a data communication relationship between a base station (or Node-B or eNode-B) and a user equipment (UE). In this case, the base station is used as a terminal node of a network via which the base station can directly communicate with the user equipment (UE). Specific operations to be conducted by the base station in the present invention may also be conducted by an upper node of the base station as necessary.

In other words, it will be obvious to those skilled in the art that various operations for enabling the base station to communicate with the user equipment (UE) in a network composed of several network nodes including the base station will be conducted by the base station or other network nodes other than the base station. The term "Base Station" may be replaced with a fixed station, Node-B, eNode-B (eNB), or an access point as necessary. The term "mobile station (MS)" may also be replaced with a user terminal, a mobile terminal, user equipment (UE) or a mobile subscriber station (MSS) as necessary.

Also, a transmission end may be indicative of a node for transmitting data or voice services, and a reception end may be indicative of another node for receiving the data or voice services. Thus, in the case of an uplink, the UE is used as the transmission end, and the eNode-B may be used as the reception end. In the case of a downlink, the UE is used as the reception end, and the eNode-B is used as the transmission end.

The following embodiments of the present invention may be supported by standard documents disclosed in at least one of various wireless access systems, for example, the IEEE 802 system, the 3GPP system, the 3GPP LTE system, and the 3GPP2 system. In other words, unexplained steps or parts for definitely disclosing the technical idea of the present invention may be supported by the above-mentioned documents. Also, all the terms or terminologies disclosed in the present invention may be explained by the above-mentioned standard documents.

Prior to describing the present invention, it should be noted that specific terms disclosed in the present invention are proposed for the convenience of description and better understanding of the present invention, and the use of these specific terms may be changed to another format within the technical scope or spirit of the present invention.

For example, a gateway for use in the following embodiments of the present invention is used as an upper entity capable of allowing a protocol to access different communication networks. Specifically, the gateway is indicative of one of protocol converters. In a broad sense, the gateway may be indicative of a functional unit which can control two or more different- or same-communication networks to be interconnected, such that information can be communicated between the different or same communication networks. In a narrow sense, the gateway may be indicative of a functional unit for allowing several communication networks having no compatibility due to different protocols of individual layers of the OSI basic reference model to be interconnected, such that it performs protocol conversion.

The gateway performs protocol conversion among several communication networks having different protocols, such that it can allow necessary information to be communicated among the communication networks. That is, the gateway can designate an IP address of a specific point which is used as a passage connected to the Internet on the condition that a TCP/IP network is connected to the external network. The gateway may reconstruct or change data during the transmission/reception of the data under communication environments. A gateway or serving gateway according to the present invention may be indicative of an upper entity which can control at least one base station and transmit data.

FIG. **2** is a flow chart illustrating an I-RAT handover process of the UE according to the present invention.

Referring to FIG. **2**, a single communication system may include a user equipment (UE) **200**, a serving eNode-B (S-eNB) **220**, a target eNode-B (T-eNB) **240**, a mobility management entity and a serving gateway (MME/S-GW) **260**.

Referring to FIG. **2**, the user equipment (UE) **200** transmits and receives packet data to/from the serving eNode-B (S-eNB) **220**. The serving eNode-B (S-eNB) **220** transmits and receives user data to/from the serving gateway (S-GW) **260**.

The UE **200** periodically transmits a measurement report to the serving eNode-B (S-eNB) **220** which manages a cell to which the UE **200** belongs at step S**201**. This measurement report may include signal intensity information or signal quality information.

If the serving eNode-B (S-eNB) **220** receives the measurement report from the UE **200**, it checks the measurement result collected by the UE **200**, and determines if it is preferable for the UE **200** to communicate with another eNode-B rather than the serving eNode-B (S-eNB) **220**. If the serving eNode-B (S-eNB) **220** determines that it is preferable for the UE **200** to communicate with another eNode-B rather than the serving eNode-B (S-eNB) **220**, it transmits a handover (HO) request message including a UE context to the another eNode-B (i.e., a target eNode-B (T-eNB)) at step S**202**.

If the target eNode-B (T-eNB) **240** receives the HO request message from the serving eNode-B (S-eNB) **220**, it transmits an HO request acknowledgment (ACK) message to the serving eNode-B (S-eNB) **220** in order to answer the HO request message at step S**203**.

At step S**203**, the target eNode-B (T-eNB) includes a cell radio network temporary identifier (C-RNTI) in the HO Request ACK message. This C-RNTI is a temporary identifier assigned for allowing the target eNode-B (T-eNB) **240** to identify the UE **200**.

The serving eNode-B (S-eNB) **220** loads the C-RNTI, which is contained in the HO request ACK message received from the target eNode-B (T-eNB) **240**, on an HO command message, such that the resultant HO command message is transmitted to the UE **200** at step S**204**.

Although the serving eNode-B (S-eNB) **220** has approved its handover to the target eNode-B (T-eNB) **240**, it is determined that the handover from the serving eNode-B (S-eNB) **220** to the target eNode-B (T-eNB) **240** is not yet completed,

such that the UE **200** is under the control of the serving eNode-B (S-eNB) **220**. Therefore, the serving gateway (S-GW) **260** transmits user data to the serving eNode-B (S-eNB) **220** at step S**205**.

The serving eNode-B (S-eNB) **220** transmits user data (i.e., downlink (DL) data) to the target eNode-B (T-eNB) **240** acting as a handover-objective eNode-B at step S**206**. That is, the serving eNode-B (S-eNB) **220** performs DL data forwarding to the target eNode-B (T-eNB) **240** at step S**206**.

If the UE **200** receives the HO command message from the serving eNode-B (S-eNB) **220**, it loads the dedicated preamble received from the target eNode-B (T-eNB) **240** on an RACH access preamble, and transmits the resultant RACH access preamble to the target eNode-B (T-eNB) **240**, such that it can be synchronized with a cell of the target eNode-B (T-eNB) **240** at step S**207**.

At step S**207**, the random access channel (RACH) is used as a shared channel used by the UE **200** accessing a communication network. Specifically, the RACH may be used for initial access or burst data transmission.

In order to answer the RACH access preamble, the target eNode-B (T-eNB) **240** transmits an RACH response message including both a timing advance value and UL allocation information to the UE **200** at step S**208**. The UL allocation information may be assigned to the UE **200** by the target eNode-B (T-eNB) **240**, such that the UE **200** can transmit a handover (HO) Confirm message to the target eNode-B (T-eNB) **240** using the UL allocation information.

The UE **200** transmits the HO Confirm message to the target eNode-B (T-eNB) **240** using uplink resources contained in the RACH access preamble at step S**209**.

Upon receiving the HO Confirm message from the UE **200**, the target eNode-B (T-eNB) **240** transmits a handover (HO) Confirm ACK message to the UE **200** in order to answer the HO Confirm message at step S**210**. The target eNode-B (T-eNB) **240** transmits a handover (HO) Complete message to the MME **260** at step S**211**. It should be noted that the above steps S**210** and S**211** are almost simultaneously carried out.

If the UE **200** has user data to be transmitted to the uplink, it transmits a scheduling request message to the target eNode-B (T-eNB) **240**, such that it requests resource allocation for transmitting uplink data at step S**212**.

Upon receiving the scheduling request message from the UE **200**, the target eNode-B (T-eNB) **240** transmits a response message (e.g., a BRS response message) having resource allocation information transmitting uplink data to the UE **200** at step S**213**.

At step S**213**, the target eNode-B (T-eNB) may include uplink resources allocated for transmitting a buffer status report (BSR) message in the response message. For example, the target eNode-B (T-eNB) may assign an uplink sharing channel (UL-SCH) to the UE.

The UE **200** having received the response message from the target eNode-B (T-eNB) **240** transmits a message, which includes the BSR having information of the amount of uplink data to be transmitted, to the target eNode-B (T-eNB) **240** at step S**214**.

Upon receiving the message having the BSR from the target eNode-B (T-eNB) **240**, the UE **200** can check the size of uplink data. Thus, the target eNode-B (T-eNB) **240** transmits the response message (e.g., the BSR response message) for allocating radio resources transmitting uplink data to the UE **200** to the UE **200** at step S**215**.

At step S**216**, the UE **200** transmits user data to the target eNode-B (T-eNB) **240** using the allocated uplink resources of the above step S**215**.

Referring to FIG. **2**, the serving gateway (S-GW) **260** having received the HO Confirm message from the target eNode-B (T-eNB) **240** may change a transmission path of user data from the serving eNode-B (S-eNB) **220** to the target eNode-B (T-eNB) **240** at step S**217**.

If the serving gateway (S-GW) **260** changes the transmission path of user data to another path, the MME **260** transmits an HO Complete ACK message to the target eNode-B (T-eNB) **240**, such that it informs the target eNode-B (T-eNB) **240** of the changing of the user data transmission path at step S**218**.

If the target eNode-B (T-eNB) **240** receives the HO Complete ACK message from the MME **260** to recognize the changed transmission path of the user data, it transmits a Release Resource Message, which requests the serving eNode-B (S-eNB) **220** to delete all information for establishing data communication with the UE **200**, to the serving eNode-B (S-eNB) **220** at step S**219**.

Upon receiving the above-mentioned message for requesting the deletion of UE information from the target eNode-B (T-eNB) **240**, it forwards downlink data packets to be transmitted to the UE **200** to the target eNode-B (T-eNB) **240** at step S**220**.

The serving eNode-B (S-eNB) **220** releases and deletes all information associated with the UE **200** at step S**221**.

By the above-mentioned steps of FIG. **2**, the UE **200** can transmit uplink data during the handover. However, in the case of using the above-mentioned steps of FIG. **2**, the UE **200** must perform a variety of processes together with the target eNode-B (T-eNB) **240** without quickly transmitting uplink data.

FIG. **3** is a flow chart illustrating a signal processing step performed when there is uplink data during the UE's handover according to one embodiment of the present invention.

Referring to FIG. **3**, a single communication system may include a user equipment (UE) **300**, a serving eNode-B (S-eNB) **320**, a target eNode-B (T-eNB) **340**, a mobility management entity (MME) **360** and a serving gateway (S-GW) **380**.

Referring to FIG. **3**, the user equipment (UE) **300** transmits and receives packet data to/from the serving eNode-B (S-eNB) **320**. The serving eNode-B (S-eNB) **320** transmits and receives user data to/from the serving gateway (S-GW) **380**.

The UE **300** periodically transmits a measurement report to the serving eNode-B (S-eNB) **320** which manages a cell to which the UE **300** belongs at step S**301**. This measurement report may include signal intensity information or signal quality information.

If the serving eNode-B (S-eNB) **320** receives the measurement report from the UE **300**, it checks the measurement result collected by the UE **300**, and determines if it is preferable for the UE **300** to communicate with another eNode-B rather than the serving eNode-B (S-eNB) **320**. If the serving eNode-B (S-eNB) **320** determines that it is preferable for the UE **300** to communicate with another eNode-B rather than the serving eNode-B (S-eNB) **320**, it transmits a handover (HO) request message including a UE context to the another eNode-B (i.e., a target eNode-B (T-eNB)) at step S**302**.

If the target eNode-B (T-eNB) **340** receives the HO request message from the serving eNode-B (S-eNB) **320**, it transmits an HO request acknowledgment (ACK) message to the serving eNode-B (S-eNB) **320** in order to answer the HO request message at step S**303**.

At step S**303**, the HO request ACK message may include a cell radio network temporary identifier (C-RNTI) and a dedicated preamble. This C-RNTI is a temporary identifier

assigned for allowing the target eNode-B (T-eNB) **340** to identify the UE **300**. This dedicated preamble is a unique code allocated to the UE **300** by the target eNode-B (T-eNB) **340**, such that it can prevent the UE **300** from colliding with other UEs during a random access process capable of establishing synchronization between the UE **300** and the target eNode-B (T-eNB) **340**.

The serving eNode-B (S-eNB) **320** loads the C-RNTI and the dedicated preamble, which are contained in the HO request ACK message received from the target eNode-B (T-eNB) **340**, on an HO command message, such that the resultant HO command message is transmitted to the UE **300** at step S**304**.

Although the serving eNode-B (S-eNB) **320** has approved its handover to the target eNode-B (T-eNB) **340**, it is determined that the handover from the serving eNode-B (S-eNB) **320** to the target eNode-B (T-eNB) **340** is not yet completed, such that the UE **100** is under the control of the serving eNode-B (S-eNB) **320**. Therefore, the serving gateway (S-GW) **380** transmits user data to the serving eNode-B (S-eNB) **320** at step S**305**.

The serving eNode-B (S-eNB) **320** forwards user data (i.e., downlink (DL) data) to the target eNode-B (T-eNB) **340** acting as a handover-objective eNode-B at step S**306**. That is, the serving eNode-B (S-eNB) **320** performs DL data forwarding to the target eNode-B (T-eNB) **340** at step S**306**.

If the UE **300** receives the HO command message from the serving eNode-B (S-eNB) **320**, it loads the dedicated preamble received from the target eNode-B (T-eNB) **340** on an RACH access preamble, and transmits the resultant RACH access preamble to the target eNode-B (T-eNB) **340**, such that it can be synchronized with a cell of the target eNode-B (T-eNB) **340** at step S**307**.

At step S**307**, the random access channel (RACH) is used as a shared channel used by the UE **300** accessing a communication network. Specifically, the RACH may be used for initial access or burst data transmission.

In order to answer the RACH access preamble, the target eNode-B (T-eNB) **340** transmits an RACH response message including both a timing advance value and UL allocation information to the UE **300** at step S**308**. The UL allocation information may be assigned to the UE **300** by the target eNode-B (T-eNB) **340**, such that the UE **300** can transmit a handover (HO) Confirm message to the target eNode-B (T-eNB) **340** using the UL allocation information.

After establishing synchronization with the target eNode-B (T-eNB) **340** by the above-mentioned steps, if there is uplink data to be transmitted to the target eNode-B (T-eNB) **340**, the UE transmits a handover (HO) Confirm message to the target eNode-B (T-eNB) **340** using uplink resources contained in the RACH message at step S**309**.

At step S**309**, the UE may include an information field indicating the presence of data to be transmitted to the uplink in the HO Confirm message. The information field may be represented by a variety of formats. For example, the information field may be represented by a flag of one bit.

FIG. **4** is a structural diagram illustrating an HO Confirm message according to another embodiment of the present invention.

Referring to FIG. **4**, the HO confirm message may include a header, a HO confirm message, and an information field. This information field may indicate whether or not the UE has uplink data. For example, the information field may indicate the presence or absence of uplink (UL) data indication by the flag of one bit (i.e., 1-bit flag).

In this case, if the 1-bit flag is represented by '1', this means that there is uplink data. If the 1-bit flag is represented by '0', this means that there is no uplink data. Needless to say, the 1-bit flag of '0' may indicate the presence of uplink data, and the other 1-bit flag of '1' may indicate the absence of uplink data.

Referring back to FIG. **3**, upon receiving the HO Confirm message from the UE **300**, the target eNode-B (T-eNB) **340** transmits a handover (HO) Confirm ACK message to the UE **300** in order to answer the HO Confirm message at step S**310**. The target eNode-B (T-eNB) **340** transmits a handover (HO) Complete message to the MME **360** at step S**311**. It should be noted that the above steps S**310** and S**311** are almost simultaneously carried out.

In this case, since the UE **300** establishes synchronization with the target eNode-B (T-eNB) **340**, it can communicate with the target eNode-B (T-eNB) **340**. Therefore, if the UE **300** has data to be transmitted to the uplink (i.e., the UE **300** has uplink data), it may transmit the uplink data transmission process together with the target eNode-B (T-eNB) **340** at step S**312**.

The MME **360** allows a specific request to be contained in a User Plane Update Request message, and transmits the resultant user plane update request message to the serving gateway (S-GW) **380** at step S**313**. In this case, this specific request may shift a DL-data transmission path formed by both the serving gateway (S-GW) **380** and the serving eNode-B (S-eNB) **320** to the target eNode-B (T-eNB) **340**.

If the serving gateway (S-GW) **380** receives the user plane update request message from the MME **360** at step S**314**, it switches a DL transmission path of the user data to another path at step S**314**, and transmits a User Plane Update Response message answering the User Plane Update request message to the MME **360** at step S**315**.

If the MME **360** receives the User Plane Update Response message from the serving gateway (S-GW) **380**, it informs the target eNode-B (T-eNB) **340** that a user data path of the serving gateway (S-GW) **380** has been switched to another, using the HO Complete ACK message at step S**316**.

If the target eNode-B (T-eNB) **340** recognizes the switching of the user data path upon receiving the HO Complete ACK message from the MME **360**, it transmits a release resource message to the serving eNode-B (S-eNB) **320** at step S**317**. In this case, the release resource message may command the serving eNode-B (S-eNB) **320** to delete all of its own information needed for implementing data communication between the serving eNode-B (S-eNB) **320** and the UE **300**.

If the serving eNode-B (S-eNB) **320** receives the above-mentioned release resource message for requesting the deletion of UE information from the target eNode-B (T-eNB) **340**, it deletes (or flushes) the UE information stored in a DL buffer at step S**318**, and forwards data packets communicating with the UE **300** to the target eNode-B (T-eNB) **340** at step S**319**. That is, the serving eNode-B (S-eNB) **320** performs the DL data forwarding at step S**319**.

The serving eNode-B (S-eNB) **320** releases and deletes all information associated with the UE **300** at step S**320**. Thereafter, the target eNode-B (T-eNB) transmits and receives data packets to/from the serving gateway (S-GW) **380**, and the UE can transmit and receive data packets to/from the target eNode-B (T-eNB) **340**.

In order to definitely disclose the technical idea of the present invention, the steps S**309** to S**312** of FIG. **3** will be described with reference to other embodiments of the present invention.

FIG. **5** is a flow chart illustrating a method for allowing the UE to transmit user data to an uplink during the handover according to yet another embodiment of the present invention.

Referring to FIG. **5**, a single communication system may include a user equipment (UE) **500**, a serving eNode-B (S-eNB) **520**, a target eNode-B (T-eNB) **540**, a mobility management entity (MME) **560**, and a serving gateway (S-GW) **580**.

Basically, steps of FIG. **5** are similar to those of FIG. **3**. Thus, only descriptions associated with the steps S**309** to S**312** will hereinafter be described to avoid repeating description of the same steps for the convenience of description.

Referring to FIG. **5**, the UE **500** transmits a Confirm message (e.g., an HO Confirm message) to the target eNode-B (T-eNB) **540** at step S**501**. At step S**501**, the confirm message of FIG. **5** may use the HO confirm message of FIG. **4**. Therefore, the UE **500** indicates the presence of uplink data in the HO confirm message, such that it may transmit the resultant HO confirm message to the target eNode-B (T-eNB) **540**.

The target eNode-B (T-eNB) **540** transmits the HO Confirm ACK message to the UE **500** in order to answer the HO Confirm message received from the UE **500** at step S**502**, and transmits the HO Complete message to the MME **560**, such that it may inform the MME **560** that the UE **500** has been shifted to a cell area managed by the target eNode-B (T-eNB) **540** at step S**503**.

The target eNode-B (T-eNB) **540** checks the HO confirm message received from the UE **500** at step S**501**. If the UE **500** has user data to be transmitted to the uplink, the target eNode-B (T-eNB) **540** allocates radio resources at step S**504**, such that the UE can transmit the user data to the target eNode-B (T-eNB) **540**.

According to yet another embodiment of the present invention, specific information capable of allocating radio resources transmitting uplink data is contained in the HO confirm response message, such that the resultant HO confirm response message including the specific information can be transmitted to the UE **500**. In this case, it should be noted that the above step S**504** may be omitted.

Referring to FIG. **5**, the UE recognizes the radio resources allocated from the target eNode-B (T-eNB) **540**, and may inform the target eNode-B (T-eNB) **540** of the amount of uplink data using the buffer status report (BSR) message at step S**505**.

The target eNode-B (T-eNB) **540** checks the BSR message received from the UE **500**. The target eNode-B (T-eNB) **540** allocates radio resources (e.g., UL-SCH) using the BSR response message in order to allow the UE to transmit uplink user data at step S**506**.

If the UE **500** receives the radio resources from the target eNode-B (T-eNB) **540**, it transmits user data to the target eNode-B (T-eNB) **540** at step S**507**.

If the MME **560** receives the HO Complete message at step S**503**, it transmits a User Plane Update Request message to the serving gateway (S-GW) **580** at step S**508**. So, a downlink transmission path is changed from the serving eNode-B (S-eNB) to the target eNode-B (T-eNB), and then the handover completion process is carried out.

By the above-mentioned embodiments shown in FIGS. **3** to **5**, uplink user data is quickly transmitted while the UE performs the handover, such that a handover delay time can be reduced.

The above embodiments are proposed by combining constituent components and characteristics of the present invention according to a predetermined format. If required, individual constituent components or characteristics may be combined with other components or characteristics. Also, some constituent components and/or characteristics may be combined to implement the embodiments of the present invention. The order of operations to be disclosed in the embodiments of the present invention may be changed to another. Some components or characteristics of any embodiment may also be included in other embodiments, or may be replaced with those of the other embodiments as necessary. It is obvious to those skilled in the art that claims having no explicit citation relationships are combined with each other to implement the embodiments, or new claims obtained by the amendment after the patent application may also be contained in the present invention without departing from the scope and spirit of the present invention.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the spirit or scope of the invention. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

INDUSTRIAL APPLICABILITY

As apparent from the above description, the above-mentioned embodiments of the present invention can be applied to a variety of wireless communication systems. Specifically, the above-mentioned embodiments may also be applied to a variety of mediums performing the handover. Also, the above-mentioned embodiments may also be applied to a variety of methods for transmitting uplink data during the I-RAT handover.

The invention claimed is:

1. A method of transmitting uplink data during a handover in a wireless access system, the method comprising:

transmitting, to a serving base station, quality of signal information periodically;

receiving, from the serving base station, a handover command (HO command) message including a dedicated preamble and an identifier of a mobile station, wherein the identifier is for use at a target base station;

synchronizing with the target base station using at least the identifier or the dedicated preamble;

transmitting, to the target base station, a handover confirm (HO Confirm) message after a completion of the synchronization with the target base station, wherein the HO Confirm message comprises a header, a handover confirm payload and an information bit, wherein the information bit indicates whether the uplink data is present;

receiving, from the target base station, information regarding a radio resource for transmitting the uplink data after a handover complete (HO Complete) message for indicating a completion of the handover of the mobile station is transmitted by the target base station to a Mobility Management Entity (MME); and

transmitting, to the target base station, the uplink data via the radio resource.

2. The method of claim **1**, wherein if the uplink data is present, the information bit is set to '1', and if the uplink data is not present, the information bit is set to '0'.

3. A method of receiving uplink data during a handover in a wireless access system, the method comprising:

receiving, from a serving base station, a message requiring a handover of a mobile station; and

transmitting, to the mobile station, a handover command (HO Command) message including an identifier of the

mobile station and a dedicated preamble, wherein the identifier is used at a target base station;

receiving, from the mobile station, a handover confirm (HO Confirm) message after a completion of a synchronization with the mobile station, wherein the HO Confirm message comprises a header, a handover confirm payload and an information bit, wherein the information bit indicates whether the uplink data is present;

transmitting, to a Mobility Management Entity (MME), a handover complete (HO Complete) message for indicating a completion of the handover of the mobile station;

allocating a radio resource for receiving the uplink data to the mobile station after the HO Complete message is transmitted, if the information bit indicates the uplink data is present; and

receiving, from the mobile station, the uplink data via the radio resource.

4. The method of claim **3**, wherein if the uplink data is present, the information bit is set to '1', and if the uplink data is not present, the information bit is set to '0'.

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